BIODIESEL PRODUCTION IN THE AMAZON REGION - A TECHNO-ECONOMIC-ENVIRONMENTAL ANALYSIS

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ABSTRACT

The Amazon region, especially the state of Amapá, lacks biofuel producing units, despite there being a large consumption of it. This work analyzes the feasibility and impacts of a biodiesel plant in the state of Amapá, using all soy produced in the state itself. For this, an economic analysis was carried out using NPV (Net Present Value) and an environmental analysis using LCA (Life Cycle Assessment). It was concluded that a biodiesel plant with 10m³ of daily production will bring income and jobs to the region, without significantly impacting the environment, since the main environmental impact is from the planting and harvesting of soybeans. This work could serve as a basis for future industrial ventures in the biofuels sector.

Keywords: Biodiesel. Amazon region. Techno-economic-environmental analysis. NPV. LCA.

1 INTRODUCTION

Although Brazil is the third largest producer of biodiesel in the world, with 68 plants in operation, only 7 of these plants are located in the northern region and none of them operate in the state of Amapá [1]. Amapá had a production of 19.2 tons of soybeans in the 2023/2024 harvest, a raw material responsible for producing between 70 and 85% of the national biodiesel [1, 2].

Soybean processing, in addition to biodiesel, produces a large amount of soybean meal, which is mainly used to manufacture animal feed. Amapá has a huge consumer market mainly for fish feed.

Due to the low industrial participation in Amapá, the decree that created the green free zone (ZFV) in the state of Amapá was sanctioned in 2015 by the president of the republic Dilma Rousseff. The ZFV encourages local development, offering tax incentives for the installation of production processes and production of goods in the state [3].

As a result, an economic, social and environmental analysis was carried out on the possibility of building and operating a biodiesel plant with a production capacity of 10 m³ per day, coupled to a soybean crusher, in the state of Amapá.

2 MATERIAL & METHODS

Economic analysis

To analyze the economic performance of different industrial plant configurations, Net Present Value (NPV) proves to be an effective tool. NPV is a financial metric capable of determining the present value of future payments discounted at an appropriate interest rate, minus the cost of the initial investment. If the NPV exceeds 0, the project will cover both the initial investment and the minimum remuneration required by the investor, the internal rate of return (IRR), generating a financial surplus [4] The characteristics adopted for the NPV are in Table 1.

Table 1 Economic assumptions for Net Present Value (NPV).

Characteristics	Values
Operating time	20 years 24 hours a day at the crushing plant 8 hours a day in the biodiesel production plant
Depreciation	10% of fixed cost
Depreciation time	10 years
Tax breaks	PIS/PASEP exemption, Tax exemption on manufactured products (IPI), Exemption of 75% from corporate income tax.

In Amapá, there are two industrial hubs, Macapá and Santana. These industrial hubs have a minimum area corresponding to 50 m in front and 100 m in back (50x100m). The lots are subsidized by the state, so there are no costs to the entrepreneur, as he

only needs to carry out the activities for which the lot was transferred. The other costs of implementing the project are detailed in Table 2.

Table 2 Total investment cost.

Item	Price
Biodiesel plant	R$ 657,000.00
Terrain	Subsidized
Civil construction	R$ 2,579,114.20
Crushing plant	R$ 1,880,000.00
Working capital	R$ 1,785,628.31
Additional costs	R$500,000.00
Total	R$ 7,412,607.83
Addition of ICMS	8,524,499.01

Environmental analysis

The environmental analysis of this work was based on the life cycle assessment (LCA) of the industrial process from cradle to gate. As established by ISO 14040 (2006), an inventory of process inputs and outputs was carried out, using the Global Warming Potential (GWP) indicator for a horizon of 100 years as a metric for environmental analysis, that is, GWP 100 The GWP indices were consulted in the Ecoinvent V.3.1 database and in the IPCC report [5, 6, 7].

In the agricultural phase, fertilizers, agrochemicals, fuel for agricultural machinery and transport were considered, in addition to emissions from fertilizers and the burning of fuel.

3 RESULTS & DISCUSSION

The Net Present Value obtained during the 20 years of operation was R$ 13,232,026.69, with an Internal Rate of Return (IRR) of 19%. The condition for the investment to be justifiable is that the calculated IRR is greater than the Minimum Attractive Rate of Return (MARR), which in this case is the CMPC (Weighted Average Cost of Capital) calculated at 8.56% annually. Therefore, the project's IRR is 2.22 times greater than the MARR, so the IRR method justifies the investment. In addition, 18 direct jobs will be created at this plant, not counting indirect jobs.

Life cycle assessment (LCA) showed that biodiesel production produces 647.9874 gCO_{2eq} per kg of biodiesel produced. The agricultural part of soybean production alone is responsible for 576.6852 gCO_{2eq}/kg biodiesel. The other values are: methanol 44.9044 gCO_{2eq}/kg biodiesel; H_3PO_4 responsible for 15.7622 gCO_{2eq}/kg biodiesel; hexane 6.2044 gCO_{2eq}/kg biodiesel; NaOH 3.6920 gCO_{2eq}/kg biodiesel and biomass burned for cogeneration 0.7319 gCO_{2eq}/kg biodiesel. This data can be seen in Figure 1.

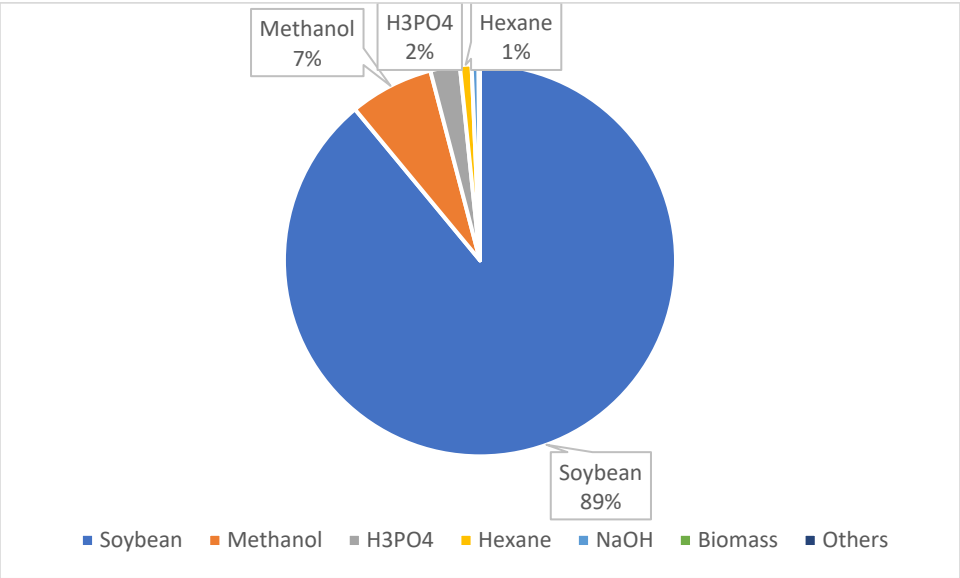

Figure 1 Life cycle assessment (LCA).

4 CONCLUSION

Using the entire soybean production capacity of Amapá, it is possible to operate an industrial plant producing 10m³ of biodiesel in the respective state. The project's total revenues would make it possible to increase the share of the industrial transformation sector by 7.61%, impacting Amapá's GDP by 0.23%. Therefore, the viability of the enterprise is justifiable both by the social impact, with the creation of jobs, and by the economic factor, by the results obtained with NPV and IRR analysis. Furthermore, there is an increase in the independence of Amapá and the Amazon region in relation to biofuels, generating an increase in industrial participation and contributing to an increase in GDP, without greatly increasing the environmental impact, since 89% of the environmental impact comes from the plantation itself. and soybean harvest.

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